

# James T. Teherani

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Assistant Professor, Department of Electrical Engineering  
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Field of specialization: semiconductor device physics

## Education

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**Massachusetts Institute of Technology** GPA 5.0/5.0  
PhD Electrical Engineering and Computer Science 2015  
Thesis: Fundamental Limits of the Switching Abruptness of Tunneling Transistors  
Advisors: Prof. Judy Hoyt and Prof. Dimitri Antoniadis  
S.M. Electrical Engineering and Computer Science 2010  
Thesis: Band-to-band Tunneling in Silicon Diodes and Tunnel Transistors  
Advisors: Prof. Judy Hoyt and Prof. Dimitri Antoniadis  
**The University of Texas at Austin** GPA 4.0/4.0  
B.S. Electrical and Computer Engineering, Highest Honors 2008

## Professional Experience

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**Columbia University** 2015 – Present  
*Assistant Professor in the Department of Electrical Engineering*  
**MIT Department of Electrical Engineering and Computer Science** 2008 – 2015  
*Semiconductor device physics graduate researcher. Advisors: Prof. Hoyt and Prof. Antoniadis*  
**IBM Research**, T. J. Watson Research Center, Yorktown Heights, New York Summer 2009  
*Device physics intern. Advisor: Dr. Paul Solomon*  
**DRS Infrared Technologies**, Dallas, Texas Summer 2005, 2007  
*Engineering intern. Advisor: Jeffrey Beck*

## Teaching Experience

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ELEN E4301: Introduction to Semiconductor Devices Fall 2015  
*Student evaluations: course 4.94/5, instructor 4.75/5*  
ELEN E3106: Solid-state Devices and Materials (co-taught with Prof. Kymissis) Fall 2015  
*Student evaluations: course 3.88/5, instructor 4.50/5*  
ENGI E1102: The Art of Engineering, EE Lab Fall 2015, Spring 2016

## Supervised Research

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Undergraduate: Rebecca Murray, sophomore in Electrical Engineering Spring 2016  
*Numerical Modeling of Auger Generation*

**Theses**

Committee member: Daniel Chenet, PhD in Mechanical Engineering  
*2D Materials: Synthesis, Characterization, and Applications*, joined Intel

Spring 2016

**Publications**

(by convention, main PI is typically listed last)

- J. Teherani, W. Chern, S. Agarwal, J. Hoyt, and D. Antoniadis, "A framework for generation and recombination in tunneling field-effect transistors," in 2015 Fourth Berkeley Symposium on Energy Efficient Electronic Systems (E3S), 2015, pp. 1–3.
- J. Teherani, "Fundamental limits of the switching abruptness of tunneling transistors," Thesis, Massachusetts Institute of Technology, 2015.
- J. Teherani, W. Chern, D. Antoniadis, and J. Hoyt, "Ultra-Thin, High Quality HfO<sub>2</sub> on Strained-Ge MOS Capacitors with Low Leakage Current," *ECS Transactions (also presented at the ECS SiGe, Ge, and Related Compounds Symposium)*, vol. 64, no. 6, pp. 267–271, Oct. 2014.
- T. Yu, J. Teherani, D. Antoniadis, and J. Hoyt, "Effects of substrate leakage and drain-side thermal barriers in In<sub>0.53</sub>Ga<sub>0.47</sub>As/GaAs<sub>0.5</sub>Sb<sub>0.5</sub> quantum-well tunneling field-effect transistors," *Appl. Phys. Express*, vol. 7, no. 9, p. 094201, Sep. 2014.
- S. Agarwal, J. Teherani, J. Hoyt, D. Antoniadis, and E. Yablonovitch. "Engineering the Electron-Hole Bilayer Tunneling Field-Effect Transistor," *IEEE Transactions on Electron Devices*, vol. 61, no. 5, pp. 1599–1606, April 2014.
- W. Chern, P. Hashemi, J. Teherani, D. Antoniadis, and J. Hoyt, "Record Hole Mobility at High Vertical Fields in Planar Strained Germanium on Insulator with Asymmetric Strain," *IEEE Electron Device Letters*, vol. 35, no. 3, pp. 309–311, March 2014.
- J. Teherani, "Uniaxial and Biaxial Stress/Strain Calculator for Semiconductors," on *nanoHUB.org*, 2014.
- T. Yu, J. Teherani, D. A. Antoniadis, and J. Hoyt, "InGaAs/GaAsSb Quantum-Well Tunnel-FETs With Tunable Backward Diode Characteristics," *IEEE Electron Device Letters*, vol. 34, no. 12, pp. 1503–1505, Dec. 2013.
- J. Teherani, T. Yu, D. Antoniadis, and J. Hoyt, "Electrostatic design of vertical tunneling field-effect transistors," *Third Berkeley Symposium on Energy Efficient Electronic Systems*, Oct. 2013.
- J. Teherani, W. Chern, D. Antoniadis, and J. Hoyt, "Simulation of Enhanced Hole Ballistic Velocity in Asymmetrically Strained Germanium Nanowire Trigate p-MOSFETs," *IEEE International Electron Devices Meeting (IEDM)*, 2013, pp. 32.4.1–32.4.4.
- J. Teherani and J. Hoyt, "A Physically-Intuitive Method for Calculation of the Local Lattice Constant from a High-Resolution Transmission Electron Microscopy Image by Fourier Analysis," *arXiv e-print 1309.3155*, Sep. 2013.
- J. Teherani, "TEM Lattice Calculator," on *nanoHUB.org*, 2013.
- S. Agarwal, J. Teherani, J. Hoyt, D. Antoniadis, and E. Yablonovitch, "Optimization of the electron hole bilayer tunneling field effect transistor," *Device Research Conference (DRC)*, 2013, pp. 109–110.

- J. Teherani**, S. Agarwal, E. Yablonovitch, J. Hoyt, and D. Antoniadis, "Impact of Quantization Energy and Gate Leakage in Bilayer Tunneling Transistors," *IEEE Electron Device Letters*, vol. 34, no. 2, pp. 298–300, Feb. 2013.
- W. Chern, P. Hashemi, **J. Teherani**, T. Yu, Y. Dong, G. Xia, D. Antoniadis, and J. Hoyt, "High mobility high-K-all-around asymmetrically-strained Germanium nanowire trigate p-MOSFETs," *IEEE International Electron Devices Meeting (IEDM)*, 2012, pp. 16.5.1–16.5.4.
- J. Teherani**, W. Chern, D. Antoniadis, J. Hoyt, L. Ruiz, C. Poweleit, and J. Menéndez, "Extraction of large valence-band energy offsets and comparison to theoretical values for strained-Si/strained-Ge type-II heterostructures on relaxed SiGe substrates," *Phys. Rev. B*, vol. 85, no. 20, p. 205308, May 2012.
- P. Hashemi, W. Chern, H. Lee, **J. Teherani**, Y. Zhu, J. Gonsalvez, G. Shahidi, and J. Hoyt, "Ultrathin Strained-Ge Channel P-MOSFETs With High-K/Metal Gate and Sub-1-nm Equivalent Oxide Thickness," *IEEE Electron Device Letters*, vol. 33, no. 7, pp. 943–945, July 2012.
- P. Solomon, I. Lauer, A. Majumdar, **J. Teherani**, M. Luisier, J. Cai, and S. Koester, "Effect of uniaxial strain on the drain current of a heterojunction tunneling field effect transistor," *IEEE Electron Device Letters*, vol. 32, no. 4, pp. 464–466, April 2011.
- J. Teherani**, "Band-to-band tunneling in silicon diodes and tunnel transistors," S.M. thesis, Massachusetts Institute of Technology, Cambridge, MA, 2010.
- P. Hashemi, **J. Teherani**, and J. Hoyt, "Investigation of hole mobility in gate-all-around Si nanowire p-MOSFETs with high-k/metal-gate: effects of hydrogen thermal annealing and nanowire shape," *IEEE International Electron Device Meeting (IEDM)*, 2010, pp. 34.5.1–34.5.4.
- J. Beck, R. Scritchfield, B. Sullivan, **J. Teherani**, C. Wan, M. Kinch, M. Ohlson, M. Skokan, L. Wood, P. Mitra, M. Goodwin, and J. Robinson, "Performance and modeling of the MWIR HgCdTe electron avalanche photodiode," *Journal of Elec. Materials (co-published in Proc. of SPIE)*, vol. 38, no. 8, pp. 1579–1592, 2009.
- H. Schaake, M. Kinch, D. Chandra, F. Aqariden, P. Liao, D. Weirauch, C.-F. Wan, R. Scritchfield, W. Sullivan, **J. Teherani**, and H. Shih, "High-Operating-Temperature MWIR Detector Diodes," *Journal of Electronic Materials*, vol. 37, no. 9, pp. 1401–1405, Sep. 2008.

## Grants

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Pending: *Investigation and Optimization of Auger Generation's Impact on TFET Performance*, National Science Foundation, 9/2016 – 9/2019, total \$600K (my portion \$430K), PI: JT, co-PI: James Hone

## Awards and Honors

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National Science Foundation Graduate Fellowship	2010 – 2015
George E. Smith Award (best paper in IEEE Electron Device Letters journal)	2014
NSF Center for Energy Efficient Electronics Science Leadership Award	2014
National Defense Science and Engineering Graduate Fellowship (NDSEG)	2010 – 2013
MIT Microsystems Technology Laboratories Annual Research Conference Featured Presenter	2013
National Nanotechnology Infrastructure Network (NNIN) International Winter School Fellow	2011
Purdue University, Network for Computation Nanotechnology Summer School Travel Scholarship	2011
Department of Energy, Science Graduate Fellowship Finalist	2010

University of Texas, Engineering Foundation Undergraduate Endowed Presidential Scholarship	2007
University of Texas, B. N. Gafford Scholarship in Electrical and Computer Engineering	2006
DRS Technologies Academic Scholarship	2006

## Invited Talks

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“Auger Generation as a Fundamental Limit to the Off-state of TFETs,” Notre Dame	2016
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## Service

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### University Service

Department of Electrical Engineering, Undergraduate Committee member	2015 – Present
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### Public Outreach

Engineering Exploration Experience workshop hosted by SWE, “How Computer Chips Work”	2016
MakeCU Hardware Hackathon, “How to Hack Like An Engineer”	2016
Science & Engineering Expo at the School at Columbia, “How to Make Computer Chips”	2016
Society of Women Engineering, Panel on Undergraduate Research	2015
MIT+K12 Videos, <a href="#">What is a Semiconductor?</a> <i>Video creator and actor.</i> Engaging, entertaining, and educational STEM video with ~31000 views.	2015
MIT+K12 Videos, <a href="#">How Computers Compute</a> <i>Video creator and actor.</i> Engaging, entertaining, and educational STEM video with ~20000 views.	2014
MIT Online Science, Technology, and Engineering Community (MOSTEC) <i>Guest lecturer.</i> STEM enrichment lecture to inspire underserved high school seniors.	2013, 2014
MIT Educational Studies Program, Spark <i>Teacher.</i> Taught Saturday classes to ~100 students middle school students on computer chip fabrication.	2013
MIT Minority Introduction to Engineering and Science (MITES) <i>Guest lecturer.</i> STEM program serving under-represented high school juniors.	2012
MIT+K12 and Khan Academy, <a href="#">Series and Parallel Circuits: A Water Analogy</a> <i>Video and experiment creator and actor.</i> Demonstration of different types of circuits with ~9000 views.	2012
Cambridge Science Festival IDEAS Competition <i>Mentor.</i> Advised team in local green technologies competition.	2012
MIT Society of Women Engineers, Women in Science & Engineering Program (WiSE) <i>Guest lecturer.</i> STEM outreach to inspire young women.	2012
MIT Society of Women Engineers, Keys to Empowering Youth <i>Guest lecturer.</i> Engineering outreach to middle school girls.	2010
University of Texas, UTeach Outreach <i>Teacher.</i> Taught a weekly hands-on science unit to four local elementary school classrooms.	2006 – 2007
University of Texas, Student Engineers Educating Kids (SEEK) <i>Mentor.</i> Academic weekly mentor to students from disadvantaged middle schools.	2006